BUREAU OF RECLAMATION
TECHNICAL SERVICE CENTER
DENVER, COLORADO

TRAVEL REPORT

RES-3.50

Code: D-8560 **Date**: March 24, 2006

To: Cliff Pugh
Manager, (D-8560) Water Resources Research Laboratory (WRRL) Group

Travelers: Tom Gill (D-8560) Hydraulic Engineer

Subject: Travel to Yuma Arizona and Surrounding Vicinity

1. Travel period: March 19-23, 2006

2. Places or offices visited: Yuma Area Office (YAO) and sites in the Yuma Mesa and Bard districts.

3. Purpose of trip: The primary objective of the trip was to install four demonstration Continuous Flow Meter (CFM) units. The trip also presented an opportunity to discuss other demonstration possibilities with YAO personnel, including low-head-availability flow measurement technology developments as well as affordable data collection, control, and telemetry systems for canal operations utilizing control units with integrated radio modems.

BACKGROUND OF CFM DEVELOPMENT: The CFM technology was initially developed at the WRRL by Blair Stringam, Kathy Frizell and Brent Mefford. Early prototype CFM units were installed in the Mohave Valley in cooperation with Mark Niblack of YAO. These prototype installations initially performed well, but the sites were subsequently heavily vandalized and remaining the equipment was ultimately taken out of the area. An initial US Patent application for the CFM was rejected. After receiving the Patent rejection, viability of continuing development of the project was reassessed by WRRL staff and demonstration site cooperators. At that time, Mark Niblack strongly urged the WRRL to develop a "How to Assemble" guide that would enable interested parties to purchase components and assemble CFM units. Programming developed by the WRRL for the CFM could be made available for download from the WRRL website to provide water users with access to a low-cost electronic flow measuring and totalizing equipment alternative.

In the process of documenting acquisition of components and assembly directions, WRRL staff learned that control modules used in the original CFM were no longer available. In place of the original modules, the manufacturer now offers units with more capabilities and lower cost. Hence, the CFM was re-configured using updated components. In a separate effort being undertaken at the same time, the technology transfer contractor employed by Reclamation resubmitted the CFM patent application. A US Patent has now been granted for the CFM concept.

4. Synopsis of trip: The CFM units for the Yuma area demonstration sites were pre-assembled at the WRRL. NEMA 4 enclosures for the units were fitted with polycarbonate windows to enable access to information displayed on the CFM's LCD display without needing access to the interior of the enclosure. Programming was loaded onto the CFM controllers and each unit was bench tested with a submersible pressure transducer at the WRRL prior to shipping them to YAO.

I left Denver on the afternoon of Sunday, (03/19/06), and after some travel complications, arrived in Yuma at about noon on Monday (03/20/06). Over the course of Monday, Tuesday and Wednesday, I worked with Ty Mull and Joe Espinoza of YAO to get the four CFM units installed. Two of the units were installed on the US Marine Corps Air Station Rangeland Farm which is part of the Yuma Mesa District. These units were installed in conjunction with long-throated flumes placed in concrete-lined canals at turnouts labeled B-62 W and B-7.0 01W respectively. Both of these CFM units were coupled with Druck submersible pressure transducers installed in 2" PVC pipes attached to the canal liner. At both of the Marine Corps Farm sites, GreyLine dataloggers with ultrasonic "downlooker" level sensors are also installed and functioning. During installation, we were visited by farm manager Mike Weathermax.

A third CFM unit was installed at the University of Arizona Agricultural Center's Mesa Division Farm, also in the Yuma Mesa District. This unit was installed with a FlowLine LA15 ultrasonic "downlooker" level sensor. At this site, a long-throated flume featuring both a raised crest and side constrictions was used for flow measurement. A Sutron 8210 logger and an ultrasonic sensor is installed at this site, but apparently this system is not functional at this time. Charlie Sanchez is the director of this program for U of A, but we did not meet with Charlie during the field visit.

The fourth CFM unit was installed at the Hopi Lateral turnout of the Bard District. A long-throated flume is located in a lined canal at this site. The CFM installed at this site was coupled with a FlowLine LA15 ultrasonic "downlooker" sensor. No other electronic equipment is present at this site. Ron Derma is the Bard District Manager, and Andy Foster is the Bard Water Master. Andy stopped by the site both before installation and during sensor calibration after installation was completed.

INSTALLATION ITEMS OF NOTE: The Druck pressure transducers required 12 volt excitation and needed no additional equipment. The FlowLine acoustic sensors required excitation voltage of 18 volts or greater. (Manufacturer's specs call for 12-36 volts excitation, but tests in the lab showed the units would not function with the CFMs at less than 18 volts.) To achieve the voltage boost, 12/24 DC-DC voltage converters were installed that provide 24 volts excitation. Sensor calibrations were carried out onsite at each installation by filling the canal to flume crest elevation for a zero reading plus a second reading at a higher canal stage. During calibrations it became apparent that elevation staff gages at the Marine Farm B-62 W site and at the Bard Hopi Lateral site were installed with gage zero significantly above the flume crest. Sensor calibration was performed at actual zero, and the staff reading for the higher stage calibration reading was adjusted an amount equal to the staff gage zero – crest elevation offset to achieve an accurate sensor slope and offset. As a result, the stage and discharge calculated and displayed by the CFM should have some disagreement (higher values in both cases) compared with readings of the improperly positioned gages affixed to the canal lining. It was also noted that the B-62-W site also appears to operate under excessive submergence conditions at high discharge rates – which reportedly are not uncommon at this site.

The "smoked" polycarbonate windows installed in the NEMA 4 enclosures might be dark enough to make it difficult to read the CFM displays. For future installations, clear polycarbonate would be preferable. (The smoked panes were made from excess materials available at the WRRL shops.)

Each of the CFM installations features a 20 watt solar panel and a 7 amp-hour gel cell deep cycle battery. Apparently YAO has experienced insufficient power issues with the GreyLine units which are coupled with ultrasonic sensors. They have gone to 35 watt panels and larger batteries for these installations. This will be a good opportunity to compare power consumption.

In an additional activity, we visited a site where YAO has installed a MACE AgriFlo ADCP flow meter. Ty Mull suggested that in their experiences with the MACE units, erratic level sensing was of greatest concern to them. Ty made a significant depth calibration adjustment to the MACE unit while were at this site. It was not clear whether this was needed due to inaccurate previous depth calibration, or due to sensor drift.

Field work and site visits were completed on Wednesday. I returned home on Thursday.

Conclusions: The four CFM installation sites should provide an opportunity to develop good field performance feedback data. Yuma climatic conditions will definitely provide insight into the effects of heat with the CFM units. There should also be good comparative performance observations with the GreyLine units at the two Marine Farm sites. One item that cropped up during setup of the CFMs will result in an immediate CFM code edit. The routine for entering measurement structure coefficients calls for "C1, "Offset" and "P1" values to be input by the user. These coefficients correspond to "K1",

"K2" and "u" respectively, as provided by the WinFlume program. CFM program code will be edited so that coefficient variables names are consistent with those from WinFlume.

In visiting with Ty Mull and with Andy Foster of the Bard District, there is a strong interest on behalf of YAO and on behalf of Bard in setting up a demonstration project featuring radio/control for flow monitoring and/or gate control. Ty will visit more with Bard personnel and will investigate funding sources for a cooperative demonstration project. If this project moves forward, it may be productive for WRRL staff to have a preliminary meeting with YAO and Bard personnel to discuss the capabilities and limitations of the technology and to deterine the District's objectives, and identify an appropriate approach for implementing the technology.

Action correspondence initiated: YAO will monitor CFM operations and keep contact with WRRL regarding general performance observed plus any issues encountered. YAO will advise WRRL of developments pertaining to a demonstration of radio/control equipment at Bard. WRRL will keep YAO apprised progress with submerged flume measurement technologies that are currently being developed. Possibilities for demonstration of this technology in the YAO vicinity will be explored as submerged measurement equipment is readied for field testing.

cc: Mark Niblack (USBR YAO), Ty Mull (USBR YAO)

SIGNATURES AND SURNAMES FOR:

Travel to: Yuma AZ area

Date or Dates of Travel: March 19-23, 2006

Names and Codes of Travelers: Tom Gill, D-8560

Traveler: _____ **_____**
Tom Gill, D-8560 **Date**

Noted and Dated by:

_____ **_____**
Cliff Pugh, Manager **Date**

D-8560 Water Resources Research Laboratory